Exhibit C

Part 1

Carnegie Mellon University
v.
Marvell Technology Group, LTD., and Marvell Semiconductor, Inc.

Civil Action No. 2:09-cv-00290-NBF

MARKMAN HEARING

April 12, 2010

K&L GATES

Markman Hearing

The "Correlation" Terms

"Noise Covariance Matrices"

The "Signal-Dependent" Terms

The "Viterbi Algorithm" Terms

The “Correlation” Terms

- *Correlated / Correlated Noise*
- *Correlation*
- *Correlation-Sensitive Branch Metrics*
- *Correlation-Sensitive Metric Computation Update Circuit*
- *Covariance*

The "Correlation" Terms

DISPUTED CLAIM TERMS

Correlated / Correlated Noise

'839 Patent Claims 2, 5 & '180 Patent Claim 1

CMU's PROPOSED CONSTRUCTION	MARVELL's PROPOSED CONSTRUCTION
Two items are "correlated" when they have a tendency to vary together. **"Correlated noise" means "noise with 'correlation' among 'signal samples', such as that caused by coloring by front-end equalizers, media noise, media nonlinearities, and magnetoresistive (MR) head nonlinearities."**	**"Correlated noise" means "noise having nonzero 'covariance'** (see construction of 'covariance' below)."
'839 Patent at col. 1:38-67; col. 2:3-14; col. 2:25-28; col. 4:44-50; col. 5:59-64; col. 6:14-21; col. 6:36-39; col. 6:36-43; col. 13:3-7; col. 13:38-50.	'839 Patent, at 1:38-67; 4:4-18; 4:43-47; 5:59-67; 6:5-20; 6:36-43; 6:53-65; 9:24-40; 13:3-7; 13:38-50. '839 File History, March 10, 2000 Office Action and Response thereto.

The "Correlation" Terms

DISPUTED CLAIM TERMS

Correlation

'839 Patent Claims 2, 5, 11, 16, 19, 23 & '180 Patent Claims 1, 6

CMU's PROPOSED CONSTRUCTION	MARVELL's PROPOSED CONSTRUCTION
"Correlation" means "the degree to which two or more items (here, noise in signal samples) show a tendency to vary together."	**"Correlation" means "the expected (mean) value of the product of two random variables (e.g., $E[r_i r_j]$, where r_i and r_j are signal samples at time i and time j, respectively)."**

'839 Patent at col. 1:38-67; col. 2:3-14; col. 2:25-28; col. 4:44-50; col. 6:36-col. 7:60.

'839 Patent, at 1:38-67; 4:4-18; 4:43-47; 5:59-67; 6:5-20; 6:36-43; 6:53-65; 9:24-40; 13:3-7; 13:38-50. '839 File History, March 10, 2000 Office Action and Response thereto.

The “Correlation” Terms

DISPUTED CLAIM TERMS

Correlation-Sensitive Branch Metrics

’839 Patent Claims 11, 16, 19, 23 & ’180 Patent Claim 6

CMU’s PROPOSED CONSTRUCTION	MARVELL’s PROPOSED CONSTRUCTION

“Correlation sensitive branch metrics” means “‘branch metrics’ that use ‘correlation’* in signal samples in their calculation.”

*Note: Parties do not agree on construction of “correlation.”

The “Correlation” Terms

DISPUTED CLAIM TERMS

Correlation-Sensitive Metric Computation Update Circuit

’839 Patent Claims 19, 23

CMU’s PROPOSED CONSTRUCTION	MARVELL’s PROPOSED CONSTRUCTION

“A correlation-sensitive metric computation update circuit” means “a circuit that recalculates ‘correlation*-sensitive branch metrics’ using statistics from the ‘noise statistics tracker circuit.’”

*Note: Parties do not agree on construction of “correlation.”

The "Correlation" Terms

DISPUTED CLAIM TERMS

Covariance

'839 Patent Claims 11, 16, 19, 23 & '180 Patent Claim 6

CMU's PROPOSED CONSTRUCTION	MARVELL's PROPOSED CONSTRUCTION
See "noise covariance matrices," below. **"Noise covariance matrices" means "noise statistics used to calculate the 'correlation sensitive branch metrics.'"**	**"Covariance" means "the expected (mean) value of the product of (r_i-m_i) and (r_j-m_j), where r_i and r_j are observed signal samples (at time i and time j, respectively) and m_i and m_j are the expected (mean) values of the samples (at time i and time j, respectively) (i.e., E[(r_i-m_i)($r_j m_j$)])."**
'839 Patent at 2:15-20; 2:43-47; 3:30-44; col. 5:48-55; col. 6:36-col. 8:27; col. 9:21-39; Figs. 3A-3B.	'839 Patent, at 1:57-67; 2:15-23; 3:30-44; 4:4-12; 5:59-66; 6:5-10; 6:53-65; 7:25-60; 8:6-27; 9:24-55 10:35-44; 10:38-11:10. '839 File History, March 10, 2000 Office Action and Response thereto.

The "Correlation" Terms

- Why construing these terms matters
  - Partially unclear: Marvell's read channel chips operate in environments containing "correlated noise" under both parties' construction
  - By its construction, Marvell appears to take the position that the Kavcic-Moura invention requires the calculation of a "correlation" to compute a "correlation-sensitive branch metric"
  - Initial analysis of Marvell's technical documents indicates that Marvell's "Kavcic detectors" may not calculate a correlation under Marvell's proposed construction ("the expected (mean) value of the product of two [signal samples]") when the accused products compute "correlation-sensitive branch metrics"

The "Correlation" Terms

- Exemplary usage of the terms "correlated noise" and "correlation" ***in the claims*** supports CMU's constructions

'839 Patent

> **2**. The method of claim **1** further comprising the step of receiving said signal samples, said signal samples having signal-dependent noise, correlated noise, or both signal-dependent and correlated noise associated therewith.

> **5**. The method of claim **4** further comprising the step of receiving said signal samples, said signal samples having signal-dependent noise, correlated noise, or both signal-dependent and correlated noise associated therewith.

'839 Patent at col. 14:3-6; 20-23

> **19**. A detector circuit for detecting a plurality of data from a plurality of signal samples read from a recording medium, comprising:
>
> a Viterbi-like detector circuit, said Viterbi-like detector circuit for producing a plurality of delayed decisions and a plurality of delayed signal samples from a plurality of signal samples;
>
> a noise statistics tracker circuit responsive to said Viterbi-like detector circuit for updating a plurality of noise covariance matrices in response to said delayed decisions and said delayed signal samples; and
>
> a correlation-sensitive metric computation update circuit responsive to said noise statistics tracker circuit for recalculating a plurality of correlation-sensitive branch metrics from said noise covariance matrices, said branch metrics output to said Viterbi-like detector circuit.

'839 Patent at col. 15:51-67.

The "Correlation" Terms

- There is ***<u>no express definition</u>*** of "correlation" in the specification
  - Absent an express definition, claim terms should be given their ordinary and customary meaning, that is the meaning a term would have to a person of ordinary skill in the art after reviewing the intrinsic record

    Phillips v. AWH Corp., 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc).

The "Correlation" Terms

- Usage of the "correlation" terms in the Summary of the Invention
  - "Correlation" and "correlated" are used to describe a characteristic of the noise, ***not*** as a value calculated by an equation

'839 Patent

SUMMARY OF THE INVENTION

In high density magnetic recording, noise samples corresponding to adjacent signal samples are heavily correlated as

The trellis/tree branch metric computation of the present invention is correlation-sensitive, being both signal-dependent and sensitive to correlations between noise samples. This method is termed the correlation-sensitive maximum likelihood sequence detector (CS-MLSD), or simply correlation-sensitive sequence detector (CS-SD).

'839 Patent at col. 2:1-3; 9-14.

The "Correlation" Terms

- Usage of the "correlation" terms in the Background of the Invention
  - "Correlation" is used to describe a characteristic of the noise, ***not*** as a value calculated by an equation

'839 Patent

It has long been observed that the noise in magnetic recording systems is neither white nor stationary. The non-stationarity of the media noise results from its signal dependent nature. Combating media noise and its signal dependence has thus far been confined to modifying the Euclidian branch metric to account for these effects. Zeng, et al., "Modified Viterbi Algorithm for Jitter-Dominated $1\text{-}D^2$ Channel," IEEE Trans. Magn., Vol. MAG-28, pp. 2895–97, Sept. 1992, and Lee et al., "Performance Analysis of the Modified maximum Likelihood Sequence Detector in the Presence of Data-Dependent Noise," Proceedings 26th Asilomar Conference, pp. 961–64, Oct. 1992 have derived a branch metric computation method for combating the signal-dependent character of media noise. These references ignore the correlation between noise samples. The effectiveness of

These methods do not take into consideration the correlation between noise samples in the readback signal. These correlations arise due to noise coloring by front-end equalizers, media noise, media nonlinearities, and magnetoresistive (MR) head nonlinearities. This noise coloring causes significant performance degradation at high recording densities. Thus, there is a need for an adaptive correlation-sensitive maximum likelihood sequence detector which derives the maximum likelihood sequence detector (MLSD) without making the usual simplifying assumption that the noise samples are independent random variables.

'839 Patent at col. 1:38-52; 57-67.

The “Correlation” Terms

- Usage of the “correlation” terms in the Detailed Description of the Invention
  - “Correlation” and “correlated” are used to describe a characteristic of the noise, ***not*** as a value calculated by an equation
  - “Correlation length” indicates the number of signal samples to be used in branch metric calculation
  - “Correlated” is used to describe a characteristic of the noise
  - Neither term used as a value for the measure of the “correlation”

’839 Patent

> Correlation-sensitive branch metric. In the most general case, the correlation length is L>0. The leading and trailing ISI lengths are K_l and K_t, respectively. The noise is now considered to be both correlated and signal-dependent. Joint

’839 Patent at col. 6:36-39.

The "Correlation" Terms

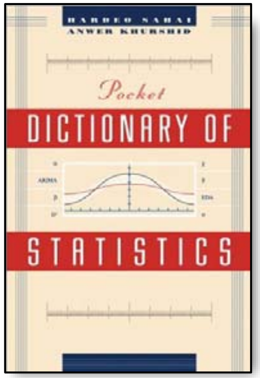
- Marvell's constructions are expressed as a ***single mathematical formula for <u>measuring</u> the extent to which two things are correlated***, it is ***<u>not</u>*** a definition of "correlation"
  - Marvell's own brief makes this distinction clear

> relationship between two sets of data. *See* Proakis Decl. at ¶ 21. To calculate the correlation, pairs of data are first multiplied together. The results of these multiplications are called products,[4] and the correlation is the mean of these products. A. Leon-Garcia, Probability and Random Processes for Electrical Engineering, at 233 (2d ed. 1994) (Exh. 18). For example, suppose that the same students who took Test #1 also took a second test where their scores were: Test #2 = [87, 72, 75, 86, 95]. To calculate the correlation between these two sets, scores are multiplied: Test #1 × Test #2 = [8004, 6120, 5250, 8256, 7315].

Marvell's Opening Claim Construction Brief at pg. 6.

The “Correlation” Terms

- Marvell’s constructions are expressed as a ***single mathematical formula for <u>measuring</u> the extent to which two things are correlated***, it is ***<u>not</u>*** a definition of “correlation”



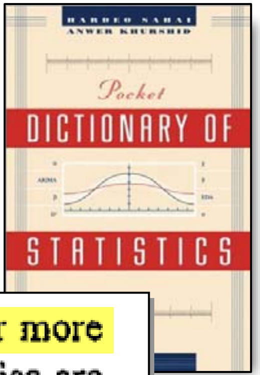
  - Marvell cites to the *Pocket Dictionary of Statistics* for the technical terms: “covariance,” “mean,” “variance,” “matrix,” and “covariance matrix”
    Marvell’s Opening Claim Construction Brief at pgs. 5, 7, 9, 20, 22, and 26.

  - Marvell ignores the definition of “correlation” found in this same reference

The "Correlation" Terms

- Marvell's constructions are expressed as a ***single mathematical formula for <u>measuring</u> the extent to which two things are correlated***, it is ***<u>not</u>*** a definition of "correlation"

  - The *Pocket Dictionary of Statistics* defines "correlation" as:



correlation– A general term denoting **association** or relationship between two or more **variables.** More generally, it is the extent or degree to which two or more quantities are associated or related. It is measured by an index called **correlation coefficient.** See also *intraclass correlation, Kendall's rank correlation, Spearman's rank correlation.*

McElhinny Declaration, 1/27/10, Ex. 10.

The "Correlation" Terms

- Marvell's assertion that CMU's construction covers the prior art (Euclidian branch metrics) is incorrect
  - This prior art branch metric equation assumes that all of the noise in the system is "***un***correlated" or white noise

'839 Patent

Euclidian branch metric. In the simplest case, the noise samples are realizations of independent identically distributed Gaussian random variables with zero mean and variance σ^2. This is a white Gaussian noise assumption. This implies that the correlation distance is L=0 and that the noise pdf s have the same form for all noise samples. The total ISI length is assumed to be $K=K_l+K_t+1$, where K_l and K_t are the leading and trailing ISI lengths, respectively. The conditional signal pdfs are factored as

'839 Patent at col. 5:59-67.

The "Correlation" Terms

- Dr. McLaughlin's unrebutted second declaration makes clear that the Euclidian branch metric dealt exclusively with ***uncorrelated noise***

16. At page 20 of Marvell's Brief, Marvell states that CMU's construction of "correlation" would encompass the Euclidian branch metric. Dr. Proakis makes a similar statement at ¶ 33 of his declaration. These statements by Marvell and Dr. Proakis are incorrect because they are premised on Marvell's and Dr. Proakis' incorrect statements that "variance is a measure of the degree to which items show a tendency to vary...." See ¶ 15 above. Additionally, these statements are contradicted by the CMU patents themselves, which explain that for the Euclidian branch metric, the noise is assumed to be white Gaussian noise. See '839 patents at col. 5:62. White Gaussian noise is uncorrelated noise, not correlated noise.

McLaughlin Second Declaration, 3/4/10 at pg. 5.

The "Correlation" Terms

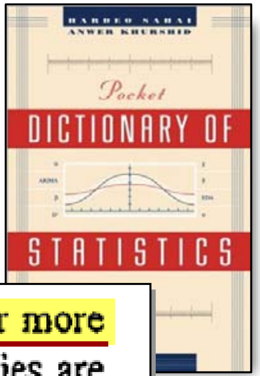
- Marvell conflates "variance" with ***co***variance/***co***rrelation
  - The CMU patents' discussion of Euclidian branch metrics uses the term "variance" (not "***co***variance")

20. **Variance:** "Variance" is a measure of the spread or the dispersion of a random variable about its mean value. [Exh. 4 at 153; Exh. 5 at 33]. The variance of a random variable X is denoted as $E[(X- m_X)^2]$ or σ_X^2. *Id.* "Variance" is calculated by first subtracting the mean from each data point to obtain deviations; multiplying each deviation by itself (squaring), which make all values positive; and then taking the average value of the squared deviations. *Id.*

Proakis Declaration, 2/18/10 at pg. 7.

The "Correlation" Terms

- Marvell conflates "variance" with ***co***variance/***co***rrelation
    - Variance only involves **ONE** variable while "correlation" requires **TWO**



correlation– A general term denoting **association** or relationship between two or more variables. More generally, it is the extent or degree to which two or more quantities are associated or related. It is measured by an index called **correlation coefficient**. See also *intraclass correlation, Kendall's rank correlation, Spearman's rank correlation.*

McElhinny Declaration, 1/27/10, Ex. 10.

The "Correlation" Terms

- Marvell conflates "variance" with ***co***variance/***co***rrelation
  - Marvell's own brief makes this distinction clear

> **2. Correlation**
>
> The mean and variance are used to characterize a single set of data, but there are other statistics used to compare two sets of data. One of these is the correlation, which measures the relationship between two sets of data. *See* Proakis Decl. at ¶ 21. To calculate the correlation,

Marvell's Opening Claim Construction Brief at pg. 6.

The "Correlation" Terms

- Marvell's file history argument undercuts its proposed construction
  - Marvell asserts that the following file history excerpt supports its construction

> Such a branch metric is not correlation sensitive, as claimed in independent claims 11, 16, and 19, which is evidenced by the fact that there is no term in the branch metric that corresponds to the correlation between $r_i(0)$ and $r_i(1)$, i.e. there is no term that involves multiplying $r_i(0)$ with $r_i(1)$. Thus, Huszar et al. does not disclose branch metrics that are

'839 File History, paper 6 at 9.

The "Correlation" Terms

- Marvell's file history argument undercuts its proposed construction
  - Marvell ignores the fact that the referenced multiplication of signal samples does not result in measuring the extent of a correlation
  - Marvell also ignores the fact that the file history discussion says nothing about using an "***expected value,***" the term at the heart of Marvell's proposed construction

MARVELL's PROPOSED CONSTRUCTION
"Correlation" means "the expected (mean) value of the product of two random variables (e.g., $E[r_i r_j]$, where r_i and r_j are signal samples at time i and time j, respectively)."

'839 Patent, at 1:38-67; 4:4-18; 4:43-47; 5:59-67; 6:5-20; 6:36-43; 6:53-65; 9:24-40; 13:3-7; 13:38-50. '839 File History, March 10, 2000 Office Action and Response thereto.

The "Correlation" Terms

- Marvell's extrinsic evidence and invalidity contentions support CMU's constructions
  - Marvell cites "the Seagate patent" for the proposition that there were prior art detectors that accounted for "correlated" noise

> By the mid-1990s, researchers had also developed detectors to account for "correlated" noise. For example, in 1995, disk-drive leader Seagate filed a patent application entitled, *Modified Viterbi Detector Which Accounts for* ***Correlated Noise***. U.S. Patent No. 6,282,251 ("the Seagate patent") (emphasis added) (Exh. 12). In that patent, Seagate disclosed using "a

Marvell's Opening Claim Construction Brief at pg. 4.

  - While the Seagate patent teaches combining signal samples, it does ***not*** calculate a "correlation"

The "Correlation" Terms

- Marvell's extrinsic evidence and invalidity contentions support CMU's constructions
  - In its invalidity contentions, Marvell cites "the Seagate patent" as teaching "correlation-sensitive branch metrics"

Invalidity of U.S. Patent No. 6,201,839

by US 6,282,251 ← Seagate Patent

'839 Claim Language	Disclosure
(a) performing a Virterbi-like sequence detection on a plurality of signal samples using a plurality of correlation sensitive branch metrics;	*See, e.g.*, 2:1-7, 4:27-44, 8:32-10:7.

Marvell's Preliminary Invalidity and Non-Infringement Contentions at pg. 88.

  - While the Seagate patent teaches combining signal samples, it does ***not*** calculate a "correlation"

Noise Covariance Matrices

Noise Covariance Matrices

DISPUTED CLAIM TERMS

Noise Covariance Matrices

’839 Patent Claims 11, 16, 19, 23 & ’180 Patent Claim 6

CMU’s PROPOSED CONSTRUCTION	MARVELL’s PROPOSED CONSTRUCTION
“Noise covariance matrices” means “noise statistics used to calculate the ‘correlation-sensitive branch metrics.’”	**“Noise covariance matrices” means “covariance matrices of signal samples (where the signal samples include noise).”**
’839 Patent at 2:15-20; 2:43-47; 3:30-44; col. 5:48-55; col. 6:36-col. 8:27; col. 9:21-39; Figs. 3A-3B.	’839 Patent, at 1:57-67; 2:15-23; 3:30-44; 4:4-12; 5:59-66; 6:5-10; 6:53-65; 7:25-60; 8:6-27; 9:24-55 10:35-44; 10:38-11:10. ’839 File History, March 10, 2000 Office Action and Response thereto.

Noise Covariance Matrices

- Why construing this term matters
  - Initial analysis of Marvell's technical documents indicates that Marvell's "Kavcic detectors" do not expressly use the C_i matrix of equation 14 when calculation branch metrics
  - Marvell's "Kavcic detectors" use one of the alternative means described in the CMU Patents for adapting the "noise covariance matrices," e.g., computing the weights (w) and variance (σ^2)

'839 Patent

$$C_i = \begin{bmatrix} \alpha_i & \underline{c}_i \\ \underline{c}_i^T & c_i \end{bmatrix}. \qquad (14)$$

'839 Patent at col. 7:27-30.

Noise Covariance Matrices

- The claim term appears in asserted claims 11, 16, 19, and 23 of '839 Patent and asserted claim 6 of the '180 Patent
  - Claim 11 of the '839 Patent is representative

'839 Patent

11. A method for detecting a sequence that exploits the correlation between adjacent signal samples for adaptively detecting a sequence of symbols stored on a high density magnetic recording device, comprising the steps of:

(a) performing a Virterbi-like sequence detection on a plurality of signal samples using a plurality of correlation sensitive branch metrics;

(b) outputting a delayed decision on the recorded symbol;

(c) outputting a delayed signal sample;

(d) adaptively updating a plurality of noise covariance matrices in response to said delayed signal samples and said delayed decisions;

(e) recalculating said plurality of correlation-sensitive branch metrics from said noise covariance matrices using subsequent signal samples; and

(f) repeating steps (a)–(e) for every new signal sample.

'839 Patent at col. 15:2-17.

Noise Covariance Matrices

- The patent contains and uses an ***express definition for "Noise Covariance Matrices***"
  - The inventors' express definition controls, *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316 (Fed. Cir. 2005) (en banc).

  - Several courts, including the Federal Circuit, have found that "i.e." defines a term absent an alternative definition in the intrinsic evidence

'839 Patent

A block diagram of a CS-MLSD detector circuit **28** is shown in FIG. **2**. The CS-MLSD detector circuit **28** is a part of the detector circuit **26** of FIG. **1**. The detector circuit **28** has a feedback circuit **32** which feeds back into a Viterbi-like detector **30**. The outputs of the detector **30** are decisions and delayed signal samples, which are used by the feedback circuit **32**. A noise statistics tracker circuit **34** uses the delayed samples and detector decisions to update the noise statistics, i.e., to update the noise covariance matrices. A metric computation update circuit **36** uses the updated statistics to calculate the branch metrics needed in the Viterbi-like algorithm. The algorithm does not require

The signal sample is delayed at step **42**. The past samples and detector decisions are used to update the noise statistics at step **44**. Branch metrics, which are used in the sequence detection step **38**, are calculated at step **46**.

'839 Patent at cols. 3:30-41; 11:16-19.

Noise Covariance Matrices

- *Marvell's reliance on Pfizer, Inc. v. Teva Pharmaceuticals, Inc.*, 429 F.3d 1364 (Fed. Cir. 2005) is misplaced

  - The patent in *Pfizer* (US 4,743,450) contained a second express definition for the claim term "saccharides"

United States Patent [19]	[11]	**Patent Number:**	**4,743,450**
Harris et al.	[45]	**Date of Patent:**	**May 10, 1988**

(b) stabilizers which contain alkaline agents alone or alkaline agents in combination with saccharides (i.e., sugars) as one or more cyclization, hydrolysis, and discoloration inhibitor(s).

SACCHARIDES

The saccharide components to be used in the pharmaceutical products and methods of the invention are substances which are compatible with the alkali or alkaline earth metal-containing stabilizers. Generally, they are substances which do not contain groups which could significantly interfere with the function of either the metal-containing component or the drug component. Mannitol, lactose, and other sugars are preferred. Mixtures are operable.

'450 Patent at cols. 1:60-63, 3:45-55

Noise Covariance Matrices

- Marvell's reliance on *Pfizer, Inc. v. Teva Pharmaceuticals, Inc.*, 429 F.3d 1364 (Fed. Cir. 2005) is misplaced

  - There is ***no second, alternate express definition of "noise covariance matrices" in the CMU patents***
  - The inventors' lexicography controls and the court should decline Marvell's invitation to construe this term without regard to the inventors' definition

Noise Covariance Matrices

- Marvell's extrinsic evidence supports CMU's proposed construction
  - "i.e." is contrasted with "e.g." – the latter ***"introduces one or more examples that illustrate something stated directly…before it"***
  - The specification uses "i.e." not "e.g."
  - The Federal Circuit has held that "i.e." is definitional
    Opening Claim Construction Brief at pg. 29.

i.e., e.g. Usage books note that these two abbreviations tend to be confused with each other. Our evidence shows that the usual error is the use of *i.e.* in place of *e.g.* The error is relatively rare in edited material, but it does seem to occur widely in speech and casual writing. To avoid it, remember that *i.e.* is an abbreviation for the Latin *id est* and means "that is"; *e.g.* is an abbreviation of *exempli gratia* and means "for example." *I.e.*, like *that is*, typically introduces a rewording or clarification of a statement that has just been made or of a word that has just been used:

> Most of the new books are sold through 3,500 Christian (i.e., Protestant) bookstores —*N.Y. Times Book Rev.*, 31 Oct. 1976

> It is money that wasn't absorbed by government, i.e. the administration tax cuts, that is spurring current growth —Joe Sneed & John Tatlock, *Houston Post*, 31 Aug. 1984

E.g. introduces one or more examples that illustrate something stated directly or shortly before it:

> Poets whose lack of these isn't made up by an inescapable intensity of personal presence (e.g. Sylvia Plath) simply aren't represented —Hugh Kenner, *N.Y. Times Book Rev.*, 17 Oct. 1976

> . . . rent them to responsible tenants, e.g., retired naval officers —David Schoenbaum, *N.Y. Times*, 3 July 1977

If you feel uncertain about which abbreviation is called for in a particular context, try substituting *that is* or *for example*, or else revise the sentence so that neither is required.

Lehav Declaration for Surreply, 3/11/10, Ex. 1, pg. 4.

Noise Covariance Matrices

- The intrinsic evidence describes embodiments for calculating “correlation-sensitive branch metrics” that use “noise covariance matrices” without using Marvell’s asserted “matrix”
  - Figs. 3A and 3B do not need to use Marvell’s “matrix”
  - Equation 23 from the ’180 Patent can be used to calculate the variance without using Marvell’s matrix.

’839 Patent

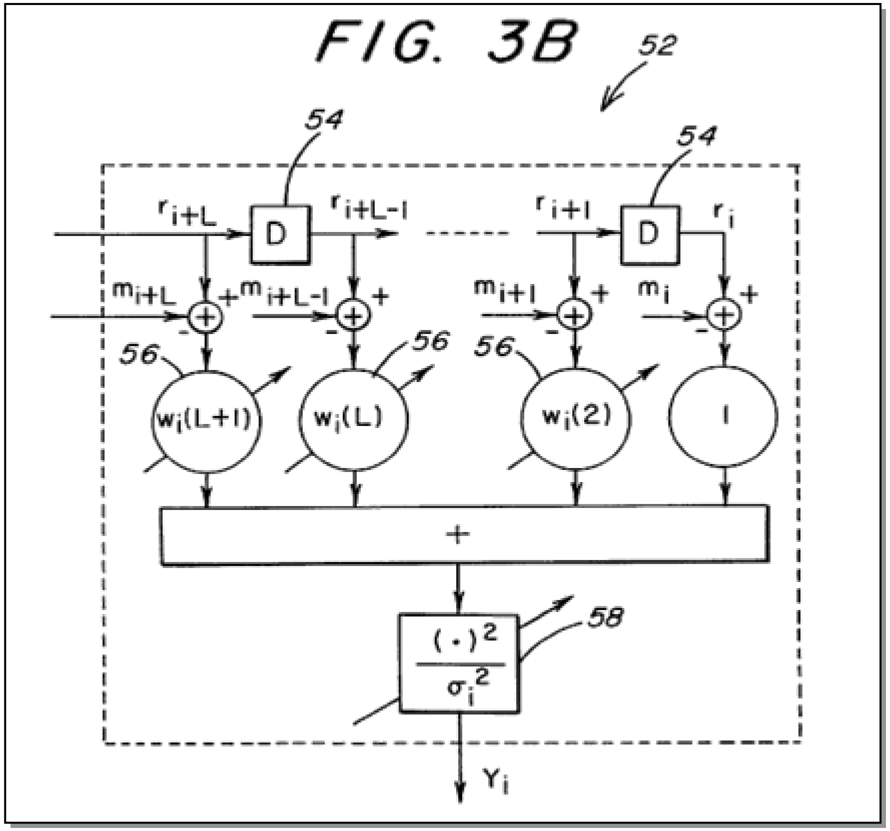


FIG. 3B

’839 Patent, Fig. 3B

Noise Covariance Matrices

- Dr. McLaughlin's unrebutted second declaration shows that equation 23 of the patents can compute the variance (σ^2) without Marvell's required "expected value"

> 9. The CMU patents identify techniques for computing the variance (σ^2) without computing a correlation value and without using a covariance matrix according to Marvell's constructions (which proposed constructions require the use of an expected value computation in the form of the equation E[*XY*], where E is the expected value and *X* and *Y* are the separate random variables). For example, equation (23) of the CMU patents (*see* '839 patent at col. 10:14) shows how to determine the variance (σ^2) without computing a correlation value and without using a covariance matrix according to Marvell's constructions. In addition, the CMU

McLaughlin Second Declaration, 3/4/10, at pg. 2.